REVISED

AQUIFER EXEMPTION REQUEST
FOR
CLASS V INJECTION WELLS
(Authorization No. 5X2700062)

April 2010

Prepared for:

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Table of Contents

List of Tables

List of Figures

List of Appendices

REVISED AQUIFER EXEMPTION REQUEST FOR CLASS V INJECTION WELLS

SIGNATURE PAGE

Signature of the Technical Report Supervisor

The revised Aquifer Exemption Application must be signed by the technical report supervisor. The supervisor must be a professional engineer, licensed in the State of Texas, or a geologist. The technical report supervisor must be competent and experienced in the Underground Injection Control and Aquifer Exemption Programs and be thoroughly familiar with the operation or project for which the application is made. Attach a copy of the supervisor's resume.

I, Brad L. Cross, Associate, certify under penalty of law that this document and all the attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluation the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature Brad L Cross Date April 13, 2010

STATE OF TEXAS
BRAD L. CROSS
GEOLOGY
No. 1401
LICENSED
PROFESSIONAL GEOSCIENTIST

(Note: Applicant Must Bear Signature and Seal of Notary Public)

SUBSCRIBED AND SWORN to before me by the said Brad Cross

On this 13th day of April, ______.

My commission expires on the 18th day of August, 2012.

JOSEPHINE W. PELLEGRINO
NOTARY PUBLIC STATE OF TEXAS
COMMISSION EXPIRES:
08-18-2012

Josephine W. Pellegrino
Notary Public in and for

Travis County, Texas

U.S. ENVIRONMENTAL PROTECTION AGENCY

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

INTRODUCTION

Background

The Kay Bailey Hutchison Desalination Plant converts brackish water from the Hueco Bolson to potable water for use by the City of El Paso and Fort Bliss. The Hueco Bolson is a major source of water for the El Paso region including the City of El Paso, Fort Bliss, and Ciudad Juárez, Mexico. This underground water resource contains significant quantities of brackish water that had historically been unused. The desalination plant allows a reduction in withdrawals of fresh water from the Hueco Bolson Aquifer and is a critical component of the water supply portfolio for the El Paso area.

Operation of the plant will be consistent with El Paso Water Utilities' (EPWU) conjunctive use of surface water from the Rio Grande and local groundwater. Specifically, during times of "full" river allocation, groundwater pumpage from the Hueco Bolson and operation of the plant will be minimal. Under "drought" conditions, groundwater from the Hueco Bolson and operation of the plant will be maximized to make up for the shortage of surface water. In addition to drought protection, the plant will be used to provide for growth, meet peak demands, and be used if there is a disruption in other supplies.

The plant treats brackish water drawn from the Hueco Bolson, referred to as "feed" water, using reverse osmosis (RO) technology. RO uses semipermeable membranes to remove dissolved solids (primarily salts) from brackish water, producing fresh water. The result is two water streams: fresh water (called "permeate") and a concentrated brine formed from the salt removed from the brackish feed water (called "concentrate"). Permeate has a very low salinity, is very pure and is mixed with brackish "blend" water, also drawn from the Hueco Bolson, prior to distribution in the public water supply. The blended water is called "finished" water and complies with federal and state drinking water standards.

The Kay Bailey Hutchison Desalination Plant is capable of producing 27.5 million gallons of fresh water daily (MGD). Concentrate disposal from the plant is currently accomplished through three deep injection wells (authorization is for five wells to be drilled), located approximately 22 miles northeast of the plant (Figure 1). EPWU received authorization from the Texas Commission on Environmental Quality (TCEQ) to construct and operate up to five Class V injection wells completed in the Fusselman Dolomite (Silurian age), the Montoya Dolomite (Ordovician age), and the El Paso Group (also of Ordovician age). The Fusselman-Montoya-El Paso Group is considered an underground source of drinking water (USDW) because the Total Dissolved Solids (TDS) of the natural formation water is below 10,000 mg/L.

The current Class V injection well authorization prohibits injecting water that does not meet primary drinking water standards, even if the formation water exceeds the primary drinking water standard for that particular parameter. Native Fusselman-Montoya-El Paso Group water samples demonstrate that the water quality does not meet national and state primary drinking water standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. In addition, the formation water is brackish with a TDS of over 8,000 mg/L.

Under current operations, the chemical composition of the dilute and non-hazardous desalination concentrate (injectate) has a TDS less than 6,000 mg/L. Thus, the concentrate has an overall higher quality than the native Fusselman-Montoya-El Paso Group water. The only parameters of the concentrate that do not meet primary drinking water standards are arsenic and gross alpha (less Ra and U). As noted above, the native Fusselman-Montoya-El Paso Group formation water contains arsenic and gross alpha that already do not meet primary drinking water standards.

Currently, the concentrate is being diluted in order to meet the requirements of authorization (i.e., arsenic and gross alpha concentrations below primary drinking water standards). While the plant is currently generating only 700 gallons per minute (gpm) of concentrate, EPWU recognizes that as water demand increases over the years, the volume of concentrate will also increase, raising the question of how to address the primary drinking water standard issue.

The most viable option in dealing with injecting concentrate that does not meet primary drinking water standards for one or more parameters is an "aquifer exemption." The U.S. Environmental Protection Agency (EPA) and TCEQ can jointly approve an aquifer exemption by finding that this use (injecting concentrate) in a USDW aquifer may be more important than or otherwise take precedence over, the use of the aquifer as a potential source of water supply for human consumption.

Aquifer exemptions require modifications to State Underground Injection Control (UIC) Programs, including public notice and participation. The exemptions are granted by TCEQ with concurrence from the EPA in accordance with 40 CFR Parts 144-146, 30 TAC and Chapter 331. The process includes submittal of an application package to TCEQ for review. Once the TCEQ reviews and tentatively approves an aquifer exemption request, the request is sent to EPA for approval.

EPA has developed a document (GWPB Guidance #34) that provides guidance to EPA Regional Offices on the process for approving modifications in delegated UIC Programs, including aquifer exemptions. Due to the lack of a formal application form, EPWU has elected to provide justification for an exemption utilizing the "Aquifer Exemption Summary Sheet" from EPA's "UIC Guidance #34." As stated in UIC Guidance #34, a distinction is drawn between "Substantial" versus "Non-Substantial" Revisions to UIC Programs. As is developed in this application, and consistent with UIC Guidance #34, the requested revision to the Texas UIC Program would be considered "Non-substantial" because (1) the TDS concentration of the proposed exempt aquifer is substantially greater than 3,000 parts per million, and (2) the formation is deep and remote. The authority for approval of a Non-Substantial revision would be delegated to the Regional Administrator.

Owner/Operator

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Facility Contact Information

Facility Name:	Kay Bailey Hutchison Desalination Plant
Location Description:	Injection well facilities are located approximately twenty-two (22) miles northeast of the Kay Bailey Hutchison Desalination Plant and a few miles south of the McGregor Range Camp.
Facility Contact Person:	Scott Reinert, P.E., P.G. (915) 594-5579

Class V Injection Well Locations

There are five permitted Class V injection wells (three active and two authorized but not drilled) associated with the proposed aquifer exemption. Although permitted as Class V injection wells, the wells were constructed in compliance with the more stringent casing and cementing requirements of Class I injection wells. The locations of the wells are as follows:

Injection Well	Status	Location (Lat./Long.)
JDF-1	Active	31° 59' 49" N 106° 06' 25" W
JDF-2	Active	31° 58' 24" N 106° 06' 30" W
JDF-3	Active	31° 59' 15" N 106° 06' 43" W
JDF-4	Authorized But Not Drilled	31° 59' 55" N 106° 07' 45" W
JDF-5	Authorized But Not Drilled	31° 59' 13" N 106° 06' 05" W

Aquifer to be Exempted

Formation Name: Fusselman Dolomite (Silurian-age) and the underlying Montoya Dolomite (Ordovician-age) and El Paso Group (Ordovician-age). (A regional stratigraphic column is included as Figure 6.) The Fusselman-Montoya-El Paso Group will collectively be referred to throughout the remainder of this report as the proposed "exempt aquifer."

Fusselman Dolomite - The Fusselman Dolomite consists of a fractured, medium gray to cream color dolomitic limestone. Electric logs (March 2005 Class V Injection Well Application) indicate that the Fusselman is approximately 590 feet thick in the proposed aquifer exemption area.

Montoya Dolomite - The Montoya Dolomite is composed of three members including the Cutter, Aleman, and Upham. The Montoya is characterized by massive beds of dolomite alternating with beds of cherts. Electric logs indicate that the Montoya is approximately 300 feet thick in the proposed aquifer exemption area.

El Paso Group - The El Paso Group consists of a series of medium to dark gray limestones and dolomites. The thickness of the entire El Paso Group in the area of the proposed aquifer exemption is undetermined. Measured thickness of the type section of the El Paso Group in the Franklin Mountains (El Paso) is 1,590 feet. The uppermost 600 feet of the group has been penetrated by the Injection Well No. 1 (JDF-1). In addition to the entire thickness of the Fusselman and Montoya Dolomites, the proposed exemption is for the entire thickness of the El Paso Group rather than the depth of penetration of JDF-1. (Injection Well No. 2 [JDF-2] did not penetrate the El Paso Group and Injection Well No. 3 [JDF-3] penetrated 125 feet of the El Paso Group.)

Subsurface Depth: Electric logs indicate the top of the proposed exempt aquifer ranges in depth from 2,222 to 2,890 feet below ground level (BGL).

Vertical Confinement: The upper confining zone for the proposed exempt aquifer consists of over 1,700 feet of continuous low-permeability shale and limestone. These units range in age from Devonian (Canutillo Formation) to Permian (Hueco Group). Confining strata beneath the lowermost interval is the Bliss Sandstone. The Bliss Sandstone (Lower Ordovician) is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The quartzite and sandstone are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

Aquifer Thickness: The proposed exempt aquifer has a thickness of approximately 2,480 feet. (The Fusselman Dolomite has a thickness of 590 feet, the Montoya Dolomite has a thickness of 300 feet, and the El Paso Group has a thickness of 1,590 feet.)

Exemption Description

The limits of the requested exempt aquifer are defined vertically as the top of the Fusselman Dolomite to the base of the El Paso Group. The upper vertical limit of the exemption ranges in depth from 2,222 to 2,890 feet BGL. At the injection site, the upper confining zone for the proposed exempt aquifer consists of more than 1,700 feet of interbedded Devonian, Mississippian, Pennsylvanian, and Permian shales and limestones. This sufficient vertical confinement is maintained throughout the proposed exemption area. Areas of less confinement are recognized outside of the proposed area of exemption.

The lower limit of the requested exempt aquifer is the base of the El Paso Group at depths ranging from 4,702 to 5,370 feet BGL. The confining stratum beneath the lowermost injection interval is the Bliss Sandstone. The Bliss Sandstone is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The sandstone and quartzite are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

The horizontal limit of the proposed exempt aquifer is defined by the lateral extent of the simulated plume and represents a concentration reduction factor of 1,000 times from the original injectate. In an effort to be conservative, a two-mile buffer zone has been added around the simulated plume. The delineation is based on a constant injection of 3 million gallons per day (MGD) over a 50-year injection period. The plume is approximately elliptical in shape with the width of the plume varying from 0.5 to 2 miles and with a length of 17 miles. The total area included in the proposed exemption (simulated plume plus two-mile buffer zone) is approximately 141.0 square miles and is located in El Paso County, Texas (Figure 1).

It is clear from geologic, gravity, and magnetic data that the aquifer is laterally extensive and correlative across the Area of Review. A map showing the proposed exempt area is included as Figure 2.

Justification for Exemption

Aquifer exemptions may be granted under EPA 40 CFR §146.4 and TCEQ 30 TAC 331.13, if:

(X) Aquifer is not a source of drinking water and will not serve as a source of drinking water in the future because it:

(X) Has a TDS level above 3,000 mg/L and less than 10,000 mg/L and is not reasonably expected to supply a public water system

( ) Is producing or capable to produce hydrocarbon

( ) Is producing or capable to produce minerals

(X) Is too deep or too remote which makes recovery of water for drinking water purposes economically or technically impractical

( ) Is above Class III area subject to subsidence

( ) Is too contaminated

EPWU respectfully requests an aquifer exemption because the formation meets the following criteria:

1. 40 CFR §146.4 Criteria for Exempted Aquifers

"An aquifer or a portion thereof which meets the criteria for an 'underground source of drinking water' may be determined under 40 CFR 144.8 to be an 'exempted aquifer' if it meets the following criteria:

(a) It does not currently serve as a source for drinking water;

There are no drinking water wells, public or private, producing water from the proposed exempt aquifer. A search of State public water supply databases (TCEQ Public Drinking Water Section and NMED Drinking Water Bureau) has revealed that there are no public water supply systems utilizing the aquifer as a source of drinking water in Texas or New Mexico.

A search of water well records (drillers' logs), public sources of data, and an on-the-ground site survey in the area indicates that the aquifer has not been nor is currently utilized as a domestic, agriculture, or industrial supply of water. Furthermore, the aquifer is an oil producing formation in West Texas and Southern New Mexico and is also used as an injection zone for disposal of oilfield brine.

2. *§146.4(b)(2) It cannot now and will not serve as a source of drinking water because: It is situated at a depth or location which makes recovery of the water for drinking water purposes economically or technologically impractical.*

The depth of the proposed exempt aquifer ranges from 2,222 to 2,890 feet. Use of the aquifer as a water resource is economically and technically impractical. Water from the proposed exempt aquifer would require treatment before use as a water resource even if injection of concentrate were not occurring. Brine concentrate would be generated during the treatment process which require disposal.

Alternative sources of drinking water (Rio Grande, Hueco Bolson, Mesilla Bolson, Capitan Reef Aquifer, Antelope Valley, Wildhorse Ranch, and Dell City) are available. These alternative sources have a higher quality and can be produced at a significantly lower cost.

Additional detail on the economic analysis is provided in the "Economic Evaluation of Alternative Water Supply Sources" section of this application.

Oil or Mineral Production History

There is no oil or mineral production history associated with the proposed exempt aquifer in the El Paso area. However, the aquifer is an oil-producing formation elsewhere in West Texas and Southeast New Mexico (Figure 3) and is also used as an injection zone for disposal of oilfield brine.

Active Injection Wells Injecting into Same Formation

Other than the three existing and two authorized/proposed EPWU Class V injection wells associated with the desalination facility, there are no injection wells completed in the proposed exempt aquifer.

Water Use in Area

The proposed exempt aquifer does not serve as a source of drinking water and there are no water supply wells that penetrate the aquifer in this area. To evaluate the production and use of groundwater from the aquifer, an on-the-ground site survey as well as a literature review and file search of the Texas Water Development Board (TWDB), TCEQ, Railroad Commission of Texas (RCC), New Mexico Environment Department (NMED), and New Mexico Energy, Minerals, and Natural Resources Department (NMEMNRD) was conducted to support the permit application.

Exceeding the suggestions in EPA UIC Guidance #34, the simulated plume area and a buffer zone of 2.0 miles was surveyed to identify any artificial penetrations (public water supply wells, domestic water wells, industrial water wells, agricultural water wells, injection wells, oil and gas wells, test holes, exploratory holes, abandoned wells, etc.). The search revealed that there are no water supply wells that penetrate the proposed exempt aquifer.

Eighty-nine (89) artificial penetrations were identified in the search; however, the artificial penetrations are relatively shallow, do not penetrate the aquifer or confining zone, and no corrective action is necessary. Thirteen narrow-diameter test holes (GT-1 through 12 and 14) were drilled in 1980 as part of a study to measure temperature gradients in the local area. Eleven of the holes are only 164 feet deep. Of the other two, Well GT-11 penetrated only a few feet into the confining zone, while Well GT-12 penetrated approximately 550 feet into the confining zone. All 13 wells were abandoned and attempts to locate them were unsuccessful. Because of the small diameter of these test holes and the length of time since their abandonment (30 years), it is reasonable to assume that these penetrations have sealed over time and are not causes for concern. Only two of the test holes (GT-6 and GT-12) are located within the Area of Review.

During the exploration and development phase of Kay Bailey Hutchison Desalination Plant design, the US Army Corps of Engineers (COE) drilled four test holes in the area to collect data that was used in evaluating the suitability of the site for injection wells. Only COE test holes TH-1 and TH-3 and the EPWU injection wells penetrate the injection zone. A tabulation of data on all artificial penetrations in the Area of Review is provided as Table 1. Artificial penetrations in Table 1 are identified with map identification numbers that are keyed to the topographic map (Figure 4). Well records available from various state agencies are provided in Appendix E.

State Agency Coordination

As part of the original application process for the authorization of the Class V injection wells and the current aquifer exemption request, coordination meetings were held with staff of the TCEQ, NMED, and EPA. The purpose of these meetings was to inform agency staff of current project status and to receive input on how to best address injecting water that does not meet primary drinking water standards even if the formation water is already above the primary standards for a particular parameter. A timeline summarizing coordination meetings as well as other project activities is included as Appendix A.

It was originally thought that a small portion of the area of exemption would extend into the State of New Mexico (Fort Bliss property) and an aquifer exemption application package was submitted to NMED. However, based on refined modeling, the plume will not migrate into New Mexico and a request for withdrawal of the original application will be submitted to NMED.

EXEMPT AQUIFER DESCRIPTION

Stratigraphy

Figure 5 is a geologic map of the area and Figure 6 is a regional stratigraphic column showing the geologic and hydrologic units in the area. The proposed aquifer exemption is located in the southeastern Basin and Range province, defined by topographically high mountain ranges and plateaus separated by adjacent down-faulted basins (bolsons). Geologic units in the area range from Precambrian to Recent. Precambrian, Paleozoic, and Tertiary igneous strata primarily outcrop in mountainous areas, Cretaceous and Permian strata outcrop in plateaus, and Tertiary and Quaternary strata are found in the bolson areas.

The oldest outcropping unit in the El Paso area is the Precambrian *Castner Formation* that was deposited as a marine offshore siliceous and carbonate mud. These sediments were lithified into alternating strata of limestones, siltstones, and shales which were later metamorphosed into marbles and hornfels. The Castner is exposed in a number of places along the eastern slopes of the Franklin Mountains (23 miles west of the proposed aquifer exemption area) and is about 1,112 feet thick. Exposures of the Castner are limited due to burial by younger unconsolidated sediments and by granitic intrusions.

Overlying the Castner Formation is a thin submarine basalt flow known as the *Mundy Breccia*. The Mundy is, in turn, overlain by a thick sequence of quartz sands that have been metamorphosed to the *Lanoria Quartzite*. The Lanoria Quartzite has similar features to those seen in modern beach systems such as the Texas Gulf Coast. A section about 2,600 feet thick can be observed in the nearby Franklin Mountains. The capping stratigraphic unit of the Lanoria is a 1,100-foot thick series of igneous intrusions. The molten rock intruded into the Castner, Mundy, and Lanoria Formations and on occasion some of the magma breached the surface to initiate a series of volcanic eruptions. These eruptions included pyroclastic ash-flow tuffs as well as numerous lava flows.

A quiet period followed and erosion of the igneous rocks began. The erosion continued until about 500 million years ago when a rising sea level gradually flooded the El Paso-Juárez region. Marine sediments that were deposited over the erosional surface were a sandy material that was lithified to form the lower Ordovician-age *Bliss Sandstone*. For the next 250 million years, the area was part of the continental shelf, a low-lying region very close to sea level that was often inundated by the sea.

Equatorial to tropical marine carbonates (limestones and dolomites) of the *El Paso Group* (Lower Ordovician) were deposited and are exposed along the east flank of the Franklin Mountains. The El Paso Group is overlain by the Upper Ordovician *Montoya Dolomite*. The formation is divided into three members (Cutter, Aleman, and Upham) and is characterized by massive beds of medium to dark gray dolomite alternating with beds of chert.

The overlying Silurian *Fusselman Dolomite* is a massive, magnesium-rich, white to gray, sugary dolomite that is approximately 640 feet thick at its type section in the Franklin Mountains and 590 feet thick in the proposed aquifer exemption area. The Fusselman is an oil-producing formation elsewhere in West Texas and Southern New Mexico and is also used as an injection zone for disposal of oilfield brine.

Overlying the Fusselman is the *Canutillo Formation* (Middle Devonian) which is unconformably separated from the overlying *Percha Shale* (Upper Devonian). The Canutillo Formation is a dark color shale containing a dense basal limestone. Approximately 175 feet of the Canutillo Formation can be found at the type locality in the Franklin Mountains and 155 feet of correlative beds in the Hueco Mountains (east of the proposed aquifer exemption). The overlying Percha Shale is 99 feet thick in the Franklin Mountains and 100 feet thick in the Hueco Mountains. It is a black, non-fossiliferous shale with local green shale lenses.

The Middle to Upper Mississippian *Las Cruces Limestone, Rancheria Formation, and Helms Shale* overlie the Devonian units. The Las Cruces Limestone consists of hard, dense, black limestone beds. The Rancheria Formation is a sequence of cherty, black, bituminous, argillaceous limestone beds that unconformably rests on the Las Cruces. The uppermost Helms Shale is characterized by shale units with minor carbonate units in the upper part.

The Pennsylvanian *Magdalena Group* overlies the Mississippian Helms Shale and is primarily composed of cliff-forming carbonates, shales, and siltstones in the nearby Franklin Mountains. Thick marine carbonates of the *Hueco Group* overlie the Magdalena Group. This Permian-age section has an upper, middle, and lower member and contains over 2,300 feet of light to dark gray limestone and shale.

At the end of the Paleozoic Era, the area was uplifted and occupied this position for most of the Mesozoic Era. During the Cretaceous, the El Paso area was near the head of an arm of the Chihuahuan Embayment, where shallow marine sediments were once again locally deposited. The Cretaceous is present in minor amounts in the Franklin Mountains, underlying the Hueco Bolson, and the Hueco Mountains (400 feet thick). Regionally, the Cretaceous is over 3,000 feet in the nearby Sierra de Juárez and Cerro Cristo Rey (both to the southwest of the project area in Mexico).

The Cenozoic Era was a time of major change in this region. Mountain building forces were in action some 45 to 50 million years ago when bodies of molten magma moved into the crust. None broke through the surface but rather cooled in the crust and are seen today as various plutons throughout the area. Shortly before emplacement occurred, compressive force developed to the southwest and as a result, great masses of Cretaceous limestone were thrust from the southwest to the northeast, forming the Sierra de Juárez.

In time, mountain-building forces waned and the region was geologically quiet until about 29 million years ago when a new system of stresses began. Major geologic features in the area formed in response to the Rio Grande rift, a fault bounded structural feature with uplifted blocks on the east/southeast and west/southwest. The rift begins near Leadville, Colorado and extends southerly through New Mexico to El Paso and then on into Mexico where it appears to die out. A product of the rifting includes the Hueco Bolson, the Hueco Mountains (to the east), the Franklin Mountains (to the west), and the Mesilla Bolson (to the west). Basin fill was derived from erosion of rocks from flanking highlands, the ancestral Rio Grande, and desert sand blown into the area from the southwest.

Hueco Bolson sediments are divisible into the *Fort Hancock Formation* and overlying *Camp Rice Formation*. The Fort Hancock Formation is a lacustrine-type deposit consisting of clays and silts in the south and east regions of the Hueco Bolson. The Camp Rice Formation consists of fluvial deposits of variable sized sands and silts located in the western Hueco Bolson.

The bolson deposits consist of alternating beds of clay, silt, sand, and gravel. The individual beds have a non-uniform character and range in thickness from inches up to about 100 feet. Because of the lenticular nature of the strata, it is difficult to correlate individual beds, even over relatively short distances. Although no wells have penetrated the entire thickness of the bolson in its westerly extent, recent seismic studies suggest that the maximum thickness of the bolson fill, which occurs within a deep structural trough paralleling the east side of the Franklin Mountains, is about 10,000 feet (Ruiz, 2004). Bolson thickness and sediment grain size generally decrease in an easterly direction across the basin. This corresponds to the change from Camp Rice (fluvial) to Fort Hancock (lacustrine) deposits.

Structural Geology

Digital Elevation Models (DEMs), aerial photographs, along with geologic, gravity, and magnetic data provided the building blocks to interpret the geologic structures at the proposed aquifer exemption site. Four geothermal exploratory slimholes drilled on the Meyer Range, approximately three to five miles northwest of the injection site, also provided information on the stratigraphy and structure of the area. Four slimholes were drilled and cored in 1996 and 1997 to evaluate a potential geothermal source of power generation in this area with a secondary objective of assessing the potential for direct use applications such as space heating or water desalination.

After evaluation of the available data, the Army Corps of Engineers (COE) drilled four test holes in 2003 at the injection site. EPWU also constructed one Class V injection well in 2004 and two Class V injection wells in 2006. These test holes and injection wells provided additional information on the lithology, porosity and permeability, groundwater geochemistry, and geologic characteristics of the area.

The University of Texas at El Paso, Department of Geological Sciences conducted a gravity survey in the area. Six geologic cross-sections (Bouguer Profiles) of the area were generated from a Bouguer Anomaly Map (Granillo, 2004) and are included as Figures 7, 8 and 9. Gravity anomaly maps depict the difference between theoretical computed gravity values and observed gravity values for a region of the earth's crust. Using isolines (lines of equal value) representing gravity (isogals), the gravity contours are overlaid on bedrock geology base maps, providing an interpretation of the regional subsurface geology. During construction of the gravity profiles (cross-sections) for the area, the gravity data was tied to EPWU injection well test hole data to assure quality interpretation of the subsurface.

A geologic structure map on top of the Fusselman has also been constructed. The structure map is based on data from the Class V injection wells as well as five cross-sections from Hawley (2007) and four cross-sections from King (1945). A regional west-east cross-section from the West Texas Geological Survey has also been included. These cross-sections were then used for the development of the Fusselman structure map and also incorporated into the numerical model. The cross-sections are included as Figures 10 through 16 and the structure map with cross-section locations is included as Figure 17.

The geologic framework of the El Paso area, which lies within the Basin and Range Province, is primarily controlled by the Rio Grande Rift which results in a series of grabens, or down-dropped basins. The Late Cenozoic basin and range faulting of the region probably initiated about Late Miocene (29 million years ago).

The bounding faults of the Franklin Mountains, located to the west of the proposed aquifer exemption, indicate a downward displacement of 10,000 feet on either side of the range. Displacements on faults that bound the Diablo Plateau, located east of the proposed aquifer exemption, form an escarpment of more than 400 feet.

Basins in the region formed by normal block faulting include the Hueco Basin and its northern extension, the Tularosa Basin, as well as the Mesilla Basin (located west of the Franklin Mountains and some 30 miles west of the proposed aquifer exemption). These block-faulted grabens are asymmetrical due to downward displacement being greater on one side of the basin than the other.

Hydrogeology

Injection wells associated with the proposed aquifer exemption encountered no groundwater of measurable quantity in the upper 453 feet of alluvial fill, and only occasional minor amounts of groundwater were observed in widely separated thin lenses of bedrock at the injection site. This is due to the wells being located in a transitional area known as the McGregor wedge. Geologically, this wedge is a Mesozoic-Paleozoic platform that forms the east rim of the Hueco basin and the western margin of the Hueco Mountains. Erosion and weathering from the Hueco Mountains have provided the alluvial fill that is present at the injection site.

The principal sources of groundwater within the region are the Hueco Bolson aquifer, the Mesilla Bolson aquifer, and the Rio Grande Alluvium aquifer (all located to the west and south of the injection site).

Underground Sources of Drinking Water (USDW)

Groundwater of measurable quantity is not encountered at the injection site until the proposed exempt aquifer is reached at depths ranging from 2,222 to 2,890 feet. The proposed exempt aquifer is under artesian pressure and rose to a height of approximately 500 feet BGL in the injection wells. Sample analyses of the aquifer are included in Table 2. The water quality does not meet national and state primary drinking water standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. In addition, the formation water is brackish with TDS of over 8,000 mg/L.

Upper and Lower Confining Zones

The upper confining zone for the proposed exempt aquifer consists of more than 1,700 feet of interbedded Devonian, Mississippian, Pennsylvanian, and Permian shales and limestones. As shown on electric logs (Class V Injection Well Application), the top of the confining zone is at a depth of 453 feet BGL with the base at depths ranging from 2,222 to 2,890 feet BGL. The confining zone provides extremely low permeability strata that prevent upward movement of injected fluids. This sufficient vertical confinement is maintained throughout the proposed exemption area. Areas of less confinement are recognized outside of the proposed area of exemption. The relative position of the upper and lower confining zones are depicted as Post-Fusselman and Pre-Fusselman on the gravity profiles (Figures 7 through 9) and on geologic cross-sections (Figures 10 through 16).

Core data for the confining zone were not available. However, lithology logs were prepared during the drilling and completion of the EPWU injection wells and the entire confining unit is well described. Analysis of 32 feet of core extracted from the Percha Shale unit of the confining zone indicates that the hydraulic conductivity within this zone is 2.7E-6 feet/day. (A copy of the complete analyses can be found in Appendix V.B.3(b)-1 of Class V Injection Well Application.)

Additionally, analysis, processing and interpretation of the Fullbore Formation Imager log were performed by Schlumberger Oilfield Services on injection wells JDF-1, JDF-2, and JDF-3. Work included image porosity analysis, fracture identification and classification, and specifically, identifying vertical fluid barriers above 2,314 feet. Analysis indicates that a good barrier is present from 2,071 feet to 2,094 feet; a very good barrier from 2,046 feet to 2,071 feet; a fair barrier from 1,921 feet to 2,046 feet; and a weak barrier from 1,799 feet to 1,921 feet. (All of the barrier depth intervals are measured from Kelly Bushing.) A description of the Schlumberger analysis is included in Appendix V.B.3(b)-2 of the Class V Injection Well Application.

The confining stratum beneath the lowermost injection interval is the Bliss Sandstone. The Bliss Sandstone is approximately 250 feet thick and consists of sandstone, quartzite, and siltstone. The sandstone and quartzite are composed of fine to medium quartz grains cemented by clay and silica, providing a low permeability stratum which prevents downward movement of injected fluids.

Aquifer Thickness

The proposed exempt aquifer is approximately 2,480 feet thick (The Fusselman is 590 feet thick, the Montoya is 300 feet thick, and the El Paso Group is 1,590 feet thick).

Injection Interval

The injection intervals in the EPWU injection wells were determined from both core analysis and a differential temperature survey. The top of the injection interval is the top of the Fusselman Formation and the base of the injection interval is the base of the El Paso Group.

Groundwater Flow

Static water level data in the injection wells supports a south to southwesterly flow direction (EPA, 1997). Groundwater movement to the south can also be interpreted by temperature gradient studies performed by Taylor (1981) and Witcher (1997). Groundwater flow in the Hueco Bolson and Diablo Plateau generally follows the elevation change of the overlying topography. In general, Hueco Bolson groundwater flow in Texas is from north to south toward the Rio Grande, except where it is diverted toward areas of significant municipal pumping. Diablo Plateau groundwater generally moves in a southerly and easterly direction discharging in the Dell Valley/Salt Flats area.

Aquifer Properties

Table 3 provides a compilation of aquifer properties for the proposed exempt aquifer. The proposed exempt aquifer has a thickness of approximately 2,480 feet and consists primarily of dolomitic limestones and alternating beds of chert. Geophysical logs indicate the top of the aquifer ranges from 2,222 to 2,890 feet BGL in the proposed aquifer exemption area. A conventional core recovered from 2,306 feet to 2,315 feet BGL in injection well JDF-1 has porosities ranging from 1.4% to 13.2% with an average porosity of 6.3%. Hydraulic conductivity of the aquifer is 7.02E-04 ft/sec and was determined from aquifer tests involving JDF-1, JDF-2, and JDF-3. Temperature was determined from initial well testing on JDF-1 and range from 155.45°F at 2,315 feet to 161.81°F at 3,765 feet. Density was measured at 1.0052 g/cm^3 in JDF-1. A viscosity value of 0.397 cp was calculated from a fluids property input module in the PanSystem2 analysis software (Van Wingen, 1950). An aquifer static pressure was measured in JDF-1 at 786.82 psia at 2,303 feet.

Aquifer Water Quality

The groundwater quality in the proposed exempt aquifer was sampled in each of the three constructed Class V injection wells and contains water that does not meet primary water quality standards for arsenic, gross alpha (less Ra and U), nitrite, and radium. TDS in injection well JDF-1 was measured at 8,260 mg/L, injection well JDF-2 was measured at 8,640 mg/L, and injection well JDF-3 was measured at 8,780 mg/L. A summary of the sample analyses for the proposed exempt aquifer is included in Table 2. Complete analyses are included in Appendix B. (A copy of the laboratory analysis for the current non-dilute concentrate is included in Appendix C.)

The arsenic standard was not met in one of the three samples collected (10.6 ug/L *vs.* a standard of 10 ug/L). The Gross Alpha standard was not met in any of the three samples (412, 620, and 774 pCi/L *vs.* a standard of 15 pCi/L). The nitrite standard was not met in one of the samples (1.14 mg/L *vs.* a standard of 1 mg/L). The radium standard (Ra-226+Ra-228) was not met in both samples collected (15 and 19 pCi/L *vs.* a standard of 5 pCi/L).

As indicated above, the aquifer is not utilized as a municipal, domestic, agricultural, or industrial source of water. In the unlikely event that the aquifer was used as a municipal supply, treatment would be required to meet primary drinking water standards. As part of the treatment process, brine concentrate would be generated and would require disposal.

RESERVOIR MODELING

A groundwater flow and transport model was developed to estimate the pressure increase and extent of the non-hazardous injectate front resulting from the injection of concentrate at a rate of 3 MGD for a 50-year period. Actual plant operation is expected to inject concentrate at a rate less than 3 MGD. As discussed in the Introduction of this report, operation of the desalination plant will be consistent with EPWU's conjunctive use of surface water from the Rio Grande and local groundwater. Specifically, during times of "full" river allocation, groundwater pumpage from the Hueco Bolson and operation of the plant will be minimal. Under "drought" conditions, groundwater from the Hueco Bolson and operation of the plant will be maximized to make up for the shortage of surface water. In addition to drought protection, the plant will be used to provide for growth, meet peak demands, and be used if there is a disruption in other supplies. As such, the areal extent of the plume presented in the modeling section is considered a worse case scenario.

The regional hydrogeology, hydrostratigraphic structure and borehole information discussed in previous sections was used as the basis for developing the conceptual model for the reservoir model. Hydraulic conductivity estimates from pumping tests were incorporated into the model and observed water level measurements in the injection wells were used to simulate aquifer flow and help calibrate the flow model. The flow and transport model was then used to estimate the area of exemption by simulating the transport of the injectate over a 50-year period.

Conceptual Model

The conceptual model and structural information for the groundwater flow and transport model was based on the regional hydrogeology and the detailed site-specific hydrogeologic information obtained from investigations of the injection area. The aquifer thickness (2,480 feet) was based on the hydrogeologic assessments near the injection facility and the geologic descriptions and geophysical logs obtained from the injection well boreholes.

The hydraulic properties in the model were based on analytical results from pressure tests performed in the injection zone. The table below summarizes the results of the pumping tests in the injection wells. Well tests were completed in JDF-2 and JDF-3 and water level measurements were collected in other wells. The analysis of the data from each pumping test is described (leftmost column) by the well that the pumping occurred in and the well that was used to monitor the pressure change. The transmissivity and storativity estimates were calculated from two different analytical methods (Jacob and Theis) for each well pair. Because the water is relatively fresh (i.e., low total dissolved solids), the hydraulic conductivity was calculated assuming standard viscosity and density of water. To calculate the hydraulic conductivity, the thickness of the open-hole interval in the wells was assumed to be 600 feet, which is the thickness of the Fusselman. This thickness is less than the entire aquifer zone (2,480 feet). The geometric mean hydraulic conductivity estimated from the pumping tests (shown on the last row of the table) was incorporated into the model. The use of the geometric mean implies that the distribution of hydraulic conductivity in the aquifer is log-normally distributed, and the flow is essentially two-dimensional (de Marsily, 1986).

Well Test	Transmissivity (ft^2/day)	Storativity	Method	Transmissivity (ft^2/sec)	Hydraulic Conductivity (ft/sec)
JDF2_1obs	34,300	1.39E-04	Theis	0.397	6.62E-04
JDF2_1obs	41,600	3.80E-05	Jacob	0.481	8.02E-04
JDF3_1obs	35,700	2.86E-05	Theis	0.413	6.89E-04
JDF3_1obs	29,000	2.90E-05	Jacob	0.336	5.59E-04
JDF3_2obs	30,700	9.50E-06	Theis	0.355	5.92E-04
JDF3_2obs	35,200	3.16E-06	Jacob	0.407	6.79E-04
JDF2_3obs	43,400	1.78E-05	Theis	0.502	8.37E-04
JDF2_3obs	44,400	1.27E-05	Jacob	0.514	8.56E-04
Geometric Mean	**36,392**	**2.04E-05**		**0.421**	**7.02E-04**

The aquifer fluid and the injectate were very similar with respect to concentration of total dissolved solids. For this reason, it was assumed that small variations in fluid density, viscosity and temperature were insignificant in determining the flow and transport of the injectate in the aquifer and therefore not considered in the reservoir modeling. The porosity value in the model was 0.063, which was the estimate from the JDF-1.

Water levels in the three injection wells were measured in March 2007. The measurements were 3,660 feet in JDF-1, 3,616 in JDF-2, and 3,633 in JDF-3. The resulting hydraulic gradient was 0.008 foot/foot in the direction 60 degrees west of south. The impact of the local faulting on the local hydraulic gradient is not known, but the northwest-southeast faulting is expected to have some impact on local water levels and flow directions. The hydraulic gradient measured at the site was used in conjunction with the regional flow patterns as a basis for setting boundary conditions on the north and south ends of the flow model. EPA (1997) documents a southerly regional flow direction in the nearby Hueco-Tularosa aquifer but indicates that flow directions near the injection wells are influenced by complex geology. For the purposes of this modeling, it was assumed that regional groundwater flow was to the south in the injection zone as well. While the local hydraulic flow gradient measured at the site (0.008 foot/foot) was considered in developing the flow model, it was determined that this local gradient did not represent regional conditions. This decision was based on two observations. First, the complex nature of the geology and faulting in the area of the wells used to estimate the gradient. Second, the local gradient (0.008 foot/foot) is significantly higher than the hydraulic gradient in the nearby Hueco-Tularosa aquifer. EPA (1997) indicates that the southerly gradient in the shallow aquifer is about 0.0015 foot/foot. Therefore, it was determined that the regional hydraulic gradient in the Fusselman-Montoya-El Paso Group was 0.003 foot/foot.

Model Description

The USGS groundwater flow code MODFLOW-2000 (Hill and others, 2000) was used to simulate pressure response in the injection zone. MODFLOW is a computer program that simulates three-dimensional ground-water flow through a porous medium by using a finite-difference method.

The MT3DMS code (Zheng and Wang, 1999) was used to simulate movement of the transport of the injectate over the 50-year injection periods. MT3DMS is designed for use with any block-centered finite-difference flow model, such as MODFLOW-2000, under the assumption of constant fluid density and full saturation.

MODFLOW-2000 and MT3DMS were selected for the modeling because both codes are well documented and publicly available. Based on aquifer and fluid testing in the injection zone, it can be assumed that fluid density and temperature are relatively constant in the injection zone and transport domain. In addition, the flow system and boundary conditions are relatively simple and the injectate is assumed to be a non-reactive fluid that does not degrade or adsorb.

Model Development and Calibration

The model grid is shown in Figure 18. The single layer MODFLOW finite-difference grid consisted of 895 rows and 552 columns, for a total of 494,040 cells. The grid was refined in the transport domain with a spacing 200 x 200 feet and the grid spacing was 1,000 x 1,000 feet for all other cells. The grid was oriented parallel to the direction of groundwater flow, which is approximately from the north to the south. The dimension of the model parallel to flow is 280,000 feet (53 miles) by 150,000 feet (28 miles) perpendicular to flow.

The thickness of the single model layer was 2,480 feet. The estimated elevation of the top of the Fusselman-Montoya-El Paso Group was used as the top elevation of the model layer wherever the Fusselman-Montoya-El Paso Group exists. However, as discussed in the structural geology section and shown in Figure 17, the Fusselman-Montoya-El Paso Group is not present in the vicinity of the Hueco Mountains. In the areas where the Fusselman-Montoya-El Paso Group is not present, only lower permeability rocks are present (King, 1945). Therefore, a no-flow zone was incorporated in those areas because it was assumed that no significant groundwater flow occurred in this area due to the uplift and low permeability rocks as shown in Figure 18.

The injection zone was assumed to be a homogeneous and isotropic porous media with a hydraulic conductivity of 7.02E-04 ft/sec, and a porosity of 0.063. The aquifer fluid was assumed to constant temperature and density, and the same as the injectate. These assumptions were based on data that demonstrate that the groundwater quality of the injected concentrate is very similar to the natural formation water in the aquifer (in terms of TDS). The longitudinal and transverse dispersivity were assumed to be 250 and 25 feet, respectively. These values are within the range of estimated dispersivity values reported by Gelhar et.al. (1992) for large, field-scale studies. Table 3 contains a summary of model input values.

The regional hydraulic gradient of 0.003 foot/foot) was implemented in the model domain by specifying head boundaries at northern edge (upgradient) of the model and on the southern edge (downgradient) of the model. The specified head on the upgradient and downgradient edges of the model were 3,800 feet (amsl) and 2,900 feet (amsl), respectively. These boundary conditions reproduce the observed water level at the site (3,630 feet amsl). The eastern and western edges of the model were considered no-flow boundaries because they are roughly parallel to the regional groundwater flow.

The model was used to simulate steady-state pressure conditions in the injection zone. Figure 19 shows the contours of the pressure head in the aquifer as simulated by the model under steady-state conditions prior to injection. The potentiometric surface indicates that flow from the injection site is south-southwest due in part to the influence of the structural high of the Fusselman-Montoya-El Paso Group associated with Hueco Mountains. The uplift causes the groundwater moving into the model area from the north to flow either to the east or west around the relatively impermeable uplifted section. As discussed above, EPA (1997) documents a similar groundwater flow pattern in the Hueco-Tularosa aquifer.

The model was used to simulate the pressure buildup in the injection zone as a result of a maximum constant rate of 3 MGD for 50 years. However, the actual rate of injection for the concentrate will be based on plant operation that will be governed by the availability of surface water, population growth, meeting peak demands, and any disruption in other supplies. It is anticipated that the actual amounts of injection will be, on the average, less than the constant rate of 3 MGD for 50 years. A steady-state simulation was completed to calculate the pressure increase. A steady-state scenario was simulated because it is considered to be the most conservative estimate as it provides the largest pressure increase and area of influence.

Figure 20 shows the steady-state pressure increase in the aquifer throughout the model area when 3 MGD is injected. The contours of pressure increase are in units of feet of water head. The model indicates that the pressure increase is less than 1.5 feet at distances greater than about a one mile from the injection wells. The pressure increase is relatively small because of the relatively high hydraulic conductivity of the aquifer. The model gridblocks are 200 x 200 feet at the injection wells and therefore the model is not appropriate for simulating well hydraulics or pressure buildup in the wellbore.

Extent of Plume

The extent of the plume was simulated by assuming constant injection at 3 MGD of injectate. The injectate was assumed to have a concentration of 1 mg/L, and the natural formation was assumed to have a concentration of 0 mg/l. Therefore, the model results can be depicted as relative concentration contours. The relative concentration (C/Co) is the calculated model concentration (C) divided by the initial concentration of the injectate. The full strength injectate has a C/Co value of 1.0. As an example, the relative concentration of 0.001 in the aquifer represents a concentration reduction factor of 1,000 times from the original injectate. Thus, the relative concentration can be used to determine the actual concentration of constituents if the injectate concentration is known. Another way to think about the relative concentration is that it represents the fraction (ranging from 0.0 to 1.0) of the original injectate that is present at a given location in the aquifer. Therefore, a relative concentration of 1.0 indicates that the water in the aquifer consists of 100% injectate. A relative concentration of 0.001 indicates that the water in the aquifer consists of 0.1% injectate.

Lateral Extent of Plume

The MT3DMS code was used to simulate the movement of the injectate for 50 years with a constant injection of 3 MGD. The extent of the plume after 10, 30, and 50 years are shown in Figures 21, 22 and 23, respectively. The figures show the migration of the plume throughout the 50-year injection period. Each figure shows the extent of the plume as represented by the relative concentration contours of 0.5, 0.1, 0.01 and 0.001. The relative concentrations are small because of the high volume of aquifer water that moves through the aquifer, resulting in a significant dilution and dispersion of the injectate in the aquifer. Because of the high dilution and dispersion, the role of molecular diffusion over the 50-year injection period is considered insignificant. Figure 23 shows that the proposed exempt area is consistent with the 0.001 relative concentration contour after 50 years.

To calculate the area of aquifer to exempt, a two–mile buffer was added to the extent of the injectate plume after 50 years as defined by the 0.001 relative concentration contour. A 50-

year projection for the injectate is included in Table 2. The proposed exempt area of the aquifer is shown in Figure 2.

Assessment of Vertical Plume Movement

Figure 24 schematically illustrates the vertical cross-section near the injection facility. As shown in the figure, there is approximately 1,700 feet of confining shale and limestone above the injection zone. Vertical migration of injectate was modeled through the confining units by calculating a conservative advective velocity through the overlying units based on the pressure increase during injection. The pressure increase was estimated by calculating the maximum pressure increase near the injection facility as simulated in the model. The model indicates that the maximum pressure increase occurred in the 200 by 200 ft model cell containing JDF-3, which is in the center of the injection area. The pressure increase at the top of the injection zone is 2.25 feet after 50 years. Based on the data shown in Figure 19, an area of about 17,088 acres experiences 1.0 foot or more of head increase.

To estimate the average vertical linear velocity through the overlying confining zone, Darcy's Law of flow through porous media was used. Darcy's Law is stated as:

$$q_s = -K \frac{dh}{dl} \frac{1}{n}$$

where:

q_s = vertical average linear velocity through confining zone (length/time)
dh = head difference across the confining zone (length)
dl = thickness of the confining zone (length)
n = effective porosity of the confining zone (-)
K = vertical hydraulic conductivity of the overlying units (length/time)

To calculate the volume of water per unit area moving upward into the confining zone (q), the vertical average linear velocity through confining zone (q_s) is multiplied by the effective porosity of the confining zone (n) as:

$$q = q_s \cdot n$$

The vertical hydraulic conductivity of the confining zone was based on the analysis of five feet of core extracted from the Percha Shale unit of the confining zone. Measured vertical hydraulic conductivity within the Percha Shale is 2.7E-6 ft/day. Assuming there is no vertical hydraulic gradient in the overlying units, the head difference across the 1,700 feet thick confining zone due to the pressure increase during injection is 2.25 feet. Assuming an effective porosity of 0.10, the vertical average linear velocity through the confining zone is calculated:

$$q_s = 2.7 \, x \, 10^{-6} \; ft/day \cdot \frac{2.25 \; ft}{1700 \; ft} \cdot \frac{1}{0.10}$$

$$q_s = 3.6 \, x \, 10^{-8} \; ft/day$$

Therefore, over the 50-year injection period, the upward vertical movement of the injected water through the overlying confining unit is:

$$3.6 \, x \, 10^{-8} \; ft/day \cdot \frac{365.25 \; day}{1 \; yr} \cdot 50 yr = 6.5 x 10^{-4} \; feet$$

The volume of injected water per unit area moving upward into the confining zone (q), is calculated as:

$$q = q_s \cdot n = 3.6 \, x \, 10^{-8} \; ft/day \cdot 0.10 = 3.6 \, x \, 10^{-9} \; ft/day$$

Making the conservative assumption that the increased pressure of 2.25 feet occurs over the entire 17,088 acres that experiences at least one foot of head increase, the volume of water moving into the confining zone through the 17,088 acres over the 50-year injection period is calculated as:

$$3.6 \, x \, 10^{-9} \; ft/day \cdot \frac{365.25 \; day}{1 \; yr} \cdot 50 yr \cdot 17088 \, acre = 1.1 \; acre-feet$$

Assuming that 3 MGD is constantly injected for 50 years, the total volume of water injected at the facility is calculated as:

$$3x10^6 \; gal/day \cdot \frac{365.25 \; day}{1 \; yr} \cdot 50 yr \cdot \frac{acre-feet}{325851 \; gal} = 168137 \; acre-feet$$

Therefore, the percentage of the injected water that moves upward into the confining zone during the 50-year injection period can be calculated as:

$$\frac{1.1\ acre-feet}{168137\ acre-feet} \cdot 100\% = 6.5\,x10^{-4}\ \%$$

ECONOMIC EVALUATION OF ALTERNATIVE WATER SUPPLY SOURCES

The proposed exempt aquifer is not a source of drinking water and will not serve as a source of drinking water in the future because it is situated at a depth and location which makes recovery of water for drinking water purposes economically and technically impractical. As previously discussed, the chemical characteristics of the aquifer would necessitate treatment prior to distribution as publicly-supplied drinking water. In addition to having a TDS level above 8,000 mg/L, the aquifer does not meet primary water quality standards for arsenic, gross alpha (less Ra and U), nitrite, and radium, making the use of groundwater from the aquifer impractical for human consumption.

Dr. Anthony Tarquin, Professor of Civil Engineering/Science Engineering at the University of Texas at El Paso, has conducted extensive research at the Center for Inland Desalination Systems on the use of membrane technology in the desalting of brackish water and wastewater. Due to the naturally occurring salinity levels in the Fusselman-Montoya-El Paso Group, Dr. Tarquin has concluded that in order for the groundwater to be used as a future source of drinking water, it would have to be subjected to rigorous treatment to remove the contaminants that are currently present. Dr. Tarquin has concluded that the injection of the concentrate would not render the groundwater either less treatable or more costly to treat than it already is. Dr. Tarquin's evaluation is included as Appendix F.

Despite the treatability of the water, the energy cost to pump from over 2,222 to 2,890 feet coupled with the disposal of brine concentrate from the treatment process make production of the proposed exempt aquifer economically impractical to render that water fit for human consumption. Production cost from the proposed exempt aquifer is estimated to be approximately $3,000 per acre-foot.

Suitable groundwater and surface water sources are available that can be treated through conventional means at a significantly less cost. Sources of water supply include the Rio Grande River, Hueco and Mesilla Bolsons, Capitan Reef, Antelope Valley, Wildhorse Ranch, and Dell City. A summary of the sources along with the estimated production/treatment costs is included in Table 4.

Rio Grande - The Rio Grande originates in southwestern Colorado and northern New Mexico, where it derives its headwaters from snowmelt in the Rocky Mountains. The Elephant Butte Dam and Reservoir in New Mexico is approximately 125 miles north of El Paso and can store over two million acre-feet of water. Water in the reservoir is stored for seasonal release to meet irrigation demands in the Rincon, Mesilla, El Paso, and Juárez Valleys. Above El Paso, flow in the River is largely controlled by releases from Caballo Reservoir located below Elephant Butte; while downstream from El Paso to Fort Quitman, flow consists of treated municipal wastewater from El Paso, treated and untreated municipal wastewater from Juárez, and irrigation return flow. El Paso obtains Rio Grande water through contracts with various irrigation districts. The cost of Rio Grande water to the city of El Paso is approximately $300 per acre-foot.

Hueco Bolson Aquifer - The Hueco Bolson aquifer extends from east of the Franklin Mountains in El Paso County southeastward into southern Hudspeth County, and is bounded on the east and north by the Hueco Mountains, the Diablo Plateau, and the Quitman Mountains. The aquifer also extends to the Sierra Juárez in Mexico. The Hueco Bolson along with the Mesilla Bolson (on the west side of the Franklin Mountains) provides approximately half of the municipal supply for the City of El Paso. It has been estimated that, in 2002, fresh groundwater storage in the El Paso portion of the Hueco Bolson was about 9.4 million acre-feet, and brackish groundwater storage (chloride concentration less than 750 mg/L) was about 12.3 million acre-feet (Hutchison, 2006). Production cost for fresh Hueco Bolson water by El Paso Water Utilities is approximately $163 per acre-foot, and production cost for brackish Hueco Bolson water including desalination at the Kay Bailey Hutchison Desalination Plant is about $534 per acre-foot.

Mesilla Bolson Aquifer - The Mesilla Bolson aquifer lies in the Upper Rio Grande Valley west of the Franklin Mountains and extends to the north into New Mexico where it is primarily used for agricultural and public supply purposes in New Mexico. The City of El Paso's Canutillo well field is located in the Mesilla Bolson. The Canutillo well field includes wells at three different depths, typically called the shallow, intermediate, and deep zones. Production cost for Mesilla Bolson water is approximately $163 per acre-foot.

Capitan Reef Aquifer - The Capitan Reef formed along the margins of the Delaware Basin, a late Paleozoic sea. The reef formed along the western and eastern edges of the basin in arc-like strips 10 to 14 miles wide. The majority of the aquifer is located in Culberson, Hudspeth, Jeff Davis, Pecos, Reeves, Ward, and Winkler Counties. The aquifer generally contains water of marginal quality, with most wells yielding water between 1,000 and 3,000 mg/L TDS. The city of El Paso has purchased Diablo Farms, which overlies the Capitan Reef in Hudspeth and Culberson Counties. Production cost from Diablo Farms for transport to El Paso is estimated to be approximately $1,000 to $1,400 per acre-foot.

Dell City - Dell City is located in northeast Hudspeth County. Groundwater in the Bone Spring-Victorio Peak Aquifer, which underlies the area, occurs in joints, fractures, and solution cavities that have developed in the nearly 2,000 feet of limestone. Groundwater in the area can be classified as slightly- to moderately-saline, with TDS of most of the aquifer water ranging from approximately 1,000 to more than 6,000 mg/L and averaging about 3,500 mg/L. Production cost from the Dell City area for transport to El Paso is estimated to be approximately $1,000 to $1,400 per acre-foot.

Antelope Valley and Wildhorse Ranch – Antelope Valley and Wildhorse Ranch are EPWU-owned lands in Culberson, Jeff Davis, and Presidio Counties. Groundwater in these areas occurs in the West Texas Bolson aquifer system, a series of fault-bounded, basin-filled aquifers. Production cost for these areas for transport to El Paso would be approximately $1,000 to $1,400 per acre-foot.

Zheng, C., and Wang, P.P., 1999, MT3DMS, A Modular Three-Dimensional Multi-Species Transport Model for Simulation of Advection, Dispersion and Chemical Reactions of Contaminants in Groundwater Systems; Documentation and User's Guide, U.S. Army Engineer Research and Development Center Contract Report SERDP-99-1, Vicksburg, MS.

Table 1 Artificial Penetrations in the Area of Review

State	State Well ID/ State Tracking No.	Owner	Driller	Year Drilled	Total Depth (ft.)	Hole Diameter (in.)	Casing Diameter (in.)	Casing Length (ft.)	Avail. Lith. Log	Remarks
Texas	JDF-1	EPWU	United Drilling	2004	3,775	17.5 – 8.75	13.4 – 6.6	0 – 3,775	Y	Class V Injection Well.
Texas	JDF-2	EPWU	United Drilling	2006	3,723	17.5 – 8.75	13.4 – 6.6	0 – 3,723	Y	Class V Injection Well.
Texas	JDF-3	EPWU	United Drilling	2006	3,996	17.5 – 8.75	13.4 – 6.6	0 – 3,996	Y	Class V Injection Well.
Texas	TH-1	Corp of Engineers	Stewart Bros.	2003	3,095	8.75 – 5.1	6.5	0 - 686	Y	COE test hole.
Texas	TH-2	Corp of Engineers	Stewart Bros.	2003	972	8.75 - 6	6.5	0 – 583	Y	COE test hole.
Texas	TH-3	Corp of Engineers	Stewart Bros.	2003	2,894	8.75 – 5.1	5	0 - 1,095	Y	COE test hole. Plugged.
Texas	TH-4	Corp of Engineers	Stewart Bros.	2003	575	8.75 – 6.25	6.5	0 - 480	Y	COE test hole.
Texas	GT-6	UTEP Study	--	1980?	164	4.5	1.25 pvc	0 - 164	--	Temperature gradient hole. Abandoned and unlocated.
Texas	GT-12	UTEP Study	--	1980?	1,006	4.5	1.25 iron	0 – 1,006	--	Temperature gradient hole. Abandoned and unlocated.
Texas	49-15-201	Richard Sharon	--	--	493	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-202	Richard Sharon	--	--	500	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-203	C.G. Candelaria	Richard Helms	1981	473	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-204	Manuel Contreras	Richard Helms	1982	490	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-205	Jerry Echols	Richard Helms	1982	460	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-206	Marcial Mendizabal	Richard Helms	1981	455	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-207	Fernando Gonzalez	Richard Helms	1981	465	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-301	El Paso County Road & Bridge	Cole Drilling Co.	1975	558	--	10.75	558	N	Shallow well and does not penetrate injection zone.
Texas	49-15-302	D.R. Ponde	--	1962	510	--	10	--	N	Shallow well and does not penetrate

										injection zone.
Texas	49-15-303	El Paso County Road & Bridge	Cole Drilling Co.	1985	508	--	10	508	N	Shallow well and does not penetrate injection zone.
Texas	49-15-304	Mountain Sun	--	--	--	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-501	Fred Kyle	Fred Kyle	1962	450	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-502	Bill Vickers	Joe Bradford	1971	430	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-503	Desert Sands Gun Club	--	1963	--	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-504	Nick Nathan	Joe Bradford	1974	--	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-506	E&L Non Profit Water Corporation	--	1978	486	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-508	Monte Vista Mobile Home Park	Lucas Drilling Co.	1981	507	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-509	Joe Hanson	Richard Helms	1982	460	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-510	Homestead M.U.D. #1	Lucas Drilling Co.	1981	480	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-511	Homestead M.U.D. #1	Aqua Drilling Co.	1982	500	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-512	Homestead M.U.D. #1	Aqua Drilling Co.	1982	505	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-513	Homestead M.U.D. #1	Aqua Drilling Co.	1982	500	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-514	Homestead M.U.D. #1	Aqua Drilling Co.	1983	505	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-515	El Paso County Road & Bridge	Cole Drilling Co.	1984	510	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-516	Eastwind Mobile Home Park	--	1984	503	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-517	Homestead M.U.D. #1	The Montana Co.	1983	516	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-518	Homestead M.U.D. #1	Cole Drilling Co.	1986	758	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-519	Homestead M.U.D. #1	Cole Drilling Co.	1986	750	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-520	Homestead M.U.D. #1	Cole Drilling Co.	1986	752	--	--	--	N	Shallow well and does not penetrate injection zone.

Texas	49-15-521	El Paso County Road & Bridge	Cole Drilling Co.	1985	670	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-523	El Paso County Road & Bridge	Cole Drilling Co.	1990	645	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-524	Homestead M.U.D. #1	Layne-Western Co.	1992	610	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-525	Homestead M.U.D. #1	Layne-Western Co.	1992	605	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-601	U.S. Geological Survey	B & W Drilling Co.	1953	1,013	--	--	--	N	Test hole, P&A.
Texas	49-15-602	J. Navar	Unknown	1976	1,100		--	--	N	Livestock well, P&A.
Texas	49-15-603	Jerry Bales	Lucas Drilling Co.	1977	420	--	6.0 – 5.0	0 – 300 300 - 320	N	Shallow well and does not penetrate injection zone.
Texas	49-15-604	Willie Nuner	Lucas Drilling Co.	1978	500	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-605	Richard Helms	Richard Lee Helms	1980	470	--	6	0 – 470	N	Shallow well and does not penetrate injection zone.
Texas	49-15-606	Clint School District	Cole Drilling Co.	1983	610	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-607	Homestead M.U.D. #1	Cole Drilling Co.	1984	605	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-608	Joe Motherne	The Montana Co.	1982	490	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-609	Homestead M.U.D. #2	Cole Drilling Co.	1986	633		12	633	N	Shallow well and does not penetrate injection zone.
Texas	49-15-610	Homestead M.U.D. #2	Cole Drilling Co.	1986	630	--	10	630	N	Shallow well and does not penetrate injection zone.
Texas	49-15-611	El Paso County Road & Bridge	Cole Drilling Co.	1986	610		10.75	610	N	Shallow well and does not penetrate injection zone.
Texas	49-15-612	Clint School District	Cole Drilling Co.	1988	622	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-613	El Paso County Road & Bridge	Unknown	1988	510	--	10	0 – 510	N	Shallow well and does not penetrate injection zone.
Texas	49-15-614	El Paso County Road & Bridge	B&G Drilling	1990	515		6	515	N	Shallow well and does not penetrate injection zone.
Texas	49-15-615	East Mountain WSC	Unknown	1985	500	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-802	--	Layne Texas Co.	1972	650	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-803	Robert Foster Inc.	Layne Texas Co.	1968	552	--	--	--	N	Shallow well and does not penetrate injection zone.

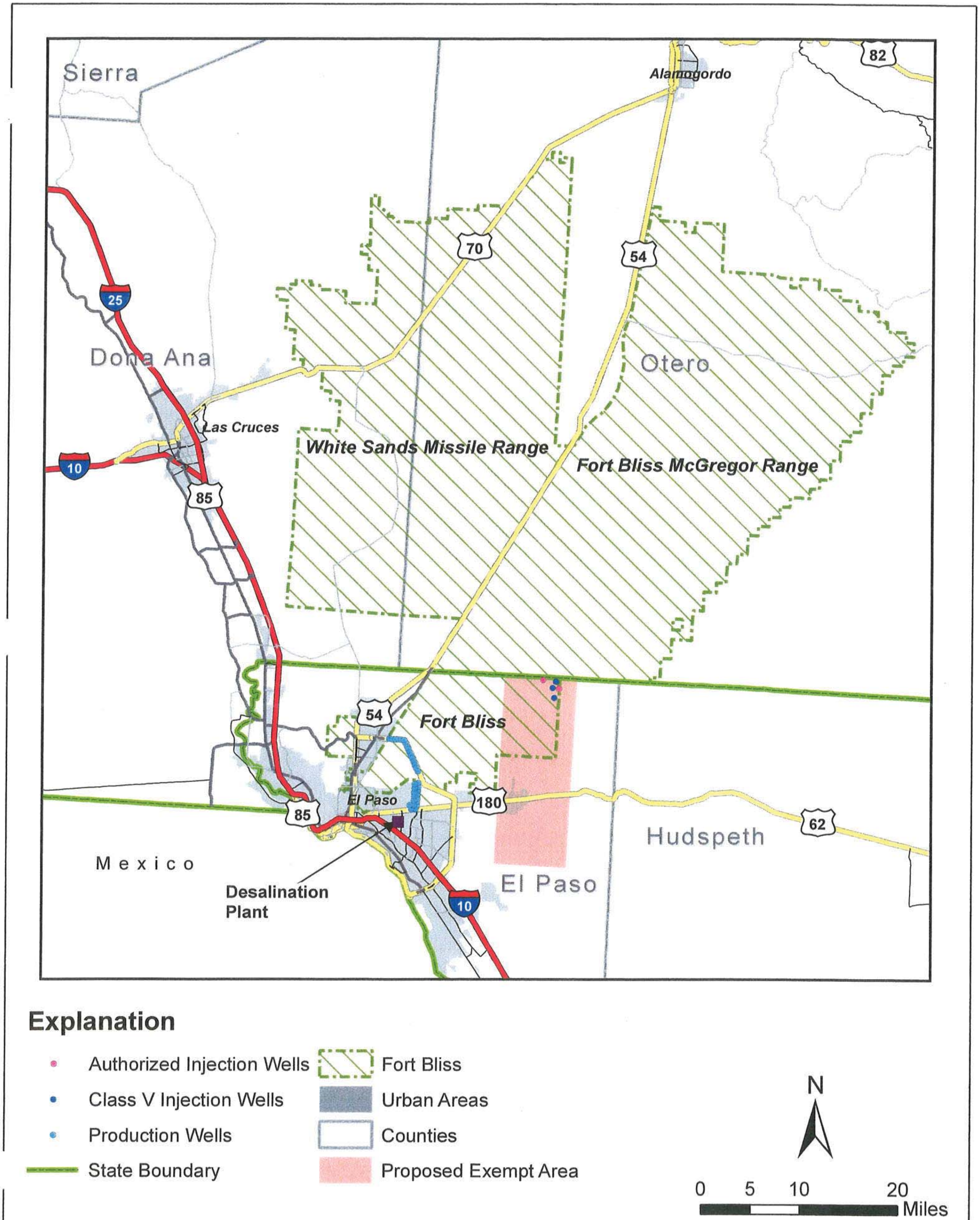
Texas	49-15-804	El Paso Natural Gas	Layne Texas Co.	1972	629	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-805	GLO	Unknown	2003	566	--	--	--	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-901	R.C. Sparks Estate	Unknown	1992	440	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-902	J. Navar	Unknown	--	1,100	--	--	--	N	No sign of well on 8/7/01
Texas	49-15-903	El Paso Natural Gas	Unknown	1968	565	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-904	El Paso Natural Gas	Layne Texas	1968	551		--	--	N	No sign of well on 8/7/01
Texas	72872	Jobe Materials	R.L. Guffey, Inc.	2005	592	23	12.75	592	Y	Industrial, reported undesirable water quality, did not complete.
Texas	89984	Jobe Materials	Skinner Drilling	2006	1,100	10	--	--	Y	Borehole and surface completed by prior driller. See #72872.
Texas	49-07-5A	Hot Wells Cattle Co.	J.B. Bradford	1977	550	12.25	--	--	Y	No water, no completion. Plugged.
Texas	49-07-9A	E.W. McCracken	Coles-Aqua Drilling Co.	1983	515	12.25	6-5/8	515	Y	Shallow well and does not penetrate injection zone.
Texas	49-07-9B	Paso View Water Corp.	Richard Lee Helms	1984	545	--	--	--	Y	No water, no completion.
Texas	49-15-2A	SS&G, Inc.	Gary Lucas	1979	493	12.25	6-5/8	490	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-2B	SS&G, Inc.	Gary Lucas	1979	496	14.25	8-5/8	496	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-2C	Bryan Ruiz	Richard Lee Helms	1981	520	14.75	--	--	Y	No water, no completion. Plugged.
Texas	49-15-2D	Gary Poras	Richard Lee Helms	1983	490	14.75	6	--	Y	No water. Plugged
Texas	49-15-2E	Marcial Mendizabac	Richard Lee Helms	1981	455	15.75	6	455	Y	Shallow well and does not penetrate injection zone. Yield 10 gpm.
Texas	49-15-3	Galindo Arcenio	Richard Lee Helms	1986	500	14.75	6	500	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-3A	Gene McCordle	Gary Lucas	1981	504	12.25	6	504	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-3X	Raul Rodriguez	Joe Salazar	1995	500	9.75	5	500	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-5(1)	Clint Ind. School District	Larjon Drilling Co.	1989	700	8.0	--	--	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-5(2)	El Paso County	West Texas Water Well Service	2001	480	6	--	--	N	Plugged.

Texas	49-15-5D	Nick Nabhan	Richard Lee Helms	1984	468	14.75	6	468	Y	Shallow well and does not penetrate injection zone. Yield 11 gpm.
Texas	49-15-5E	Bob O'Kelley	Gary Lucas	1977	500	12	6	500	Y	Shallow well and does not penetrate injection zone. Yield 5 gpm.
Texas	49-15-5L	Enrique Ortiz	B&G Drilling Co.	1984	480	6	6	477	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-6	George Demings	Richard Lee Helms	1986	502	14.75	6	502	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-6A	O.R. Boker	Richard Lee Helms	1984	500	14.75	--	--	Y	No water, no completion. Plugged.
Texas	49-15-6B	John Barnett	Richard Lee Helms	1981	545	10	--	--	Y	No water, no completion.
Texas	49-15-6C	John Barnett	Richard Lee Helms	1981	520	10	--	--	N	No water, no completion.
Texas	49-15-6E	Joe Hanson	Richard Lee Helms	1983	516	14.75	6	516	Y	Shallow well and does not penetrate injection zone. Yield 17 gpm.
Texas	49-16-1(1)	El Paso County	West Texas Water Well Service	2001	480	10	--	--	N	Plugged.
Texas	49-16-1(2)	El Paso County	West Texas Water Well Service	2001	510	6	--	--	N	Plugged.
Texas	49-16-1(3)	El Paso County	West Texas Water Well Service	2001	510	10	--	--	N	Plugged.
Texas	49-16-1(4)	El Paso County	West Texas Water Well Service	2001	500	10	--	--	N	Plugged.
Texas	49-16-1(5)	Sun City Redi-Mix	Joe Salazar Drilling Co.	1996	1,080	9-7/8	6	1,000	N	Shallow well and does not penetrate injection zone.
Texas	49-16-101	Foster-Schwartz Development Co.	Layne-Texas	1973	1,082	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-16-102	Rio Grande Materials	Salazar Drilling Co.	1996	--	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-16-201	J.L. Davis	Unknown	--	--	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-16-701	Hays	Unknown	--	334	--	--	--	N	Shallow well and does not penetrate injection zone.
Texas	49-23-301	R.C. Sparks	Unknown	1943	460	--	--	--	N	Shallow well and does not penetrate injection zone.

Table 1 Artificial Penetrations in the Area of Review

State	State Well ID/ State Tracking No.	Owner	Driller	Year Drilled	Total Depth (ft.)	Hole Diameter (in.)	Casing Diameter (in.)	Casing Length (ft.)	Avail. Lith. Log	Remarks
Texas	JDF-1	EPWU	United Drilling	2004	3,775	17.5 – 8.75	13.4 – 6.6	0 – 3,775	Y	Class V Injection Well.
Texas	JDF-2	EPWU	United Drilling	2006	3,723	17.5 – 8.75	13.4 – 6.6	0 – 3,723	Y	Class V Injection Well.
Texas	JDF-3	EPWU	United Drilling	2006	3,996	17.5 – 8.75	13.4 – 6.6	0 – 3,996	Y	Class V Injection Well.
Texas	TH-1	Corp of Engineers	Stewart Bros.	2003	3,095	8.75 – 5.1	6.5	0 - 686	Y	COE test hole.
Texas	TH-2	Corp of Engineers	Stewart Bros.	2003	972	8.75 - 6	6.5	0 – 583	Y	COE test hole.
Texas	TH-3	Corp of Engineers	Stewart Bros.	2003	2,894	8.75 – 5.1	5	0 - 1,095	Y	COE test hole. Plugged.
Texas	TH-4	Corp of Engineers	Stewart Bros.	2003	575	8.75 – 6.25	6.5	0 - 480	Y	COE test hole.
Texas	GT-6	UTEP Study	--	1980?	164	4.5	1.25 pvc	0 - 164	--	Temperature gradient hole. Abandoned and unlocated.
Texas	GT-12	UTEP Study	--	1980?	1,006	4.5	1.25 iron	0 – 1,006	--	Temperature gradient hole. Abandoned and unlocated.
Texas	49-15-301	El Paso County Road & Bridge	Cole Drilling Co.	1975	558	--	10.75	558	N	Shallow well and does not penetrate injection zone.
Texas	49-15-302	D.R. Ponde	--	1962	510	--	10	--	N	Shallow well and does not penetrate injection zone.
Texas	49-15-303	El Paso County Road & Bridge	Cole Drilling Co.	1985	508	--	10	508	N	Shallow well and does not penetrate injection zone.
Texas	49-15-601	U.S. Geological Survey	B & W Drilling Co.	1953	1,013	--	--	--	N	Test hole, P&A.
Texas	49-15-602	J. Navar	Unknown	1976	1,100		--	--	N	Livestock well, P&A.
Texas	49-15-603	Jerry Bales	Unknown	1977	420	--	6.0 – 5.0	0 – 300 300 - 320	N	Shallow well and does not penetrate injection zone.
Texas	49-15-605	Richard Helms	Richard Lee Helms	1980	470	--	6	0 – 470	N	Shallow well and does not penetrate injection zone.
Texas	49-15-609	Homestead M.U.D. #2	Cole Drilling Co.	1986	633		12	633	N	Shallow well and does not penetrate injection zone.
Texas	49-15-610	Homestead M.U.D. #2	Cole Drilling Co.	1986	630	--	10	630	N	Shallow well and does not penetrate injection zone.

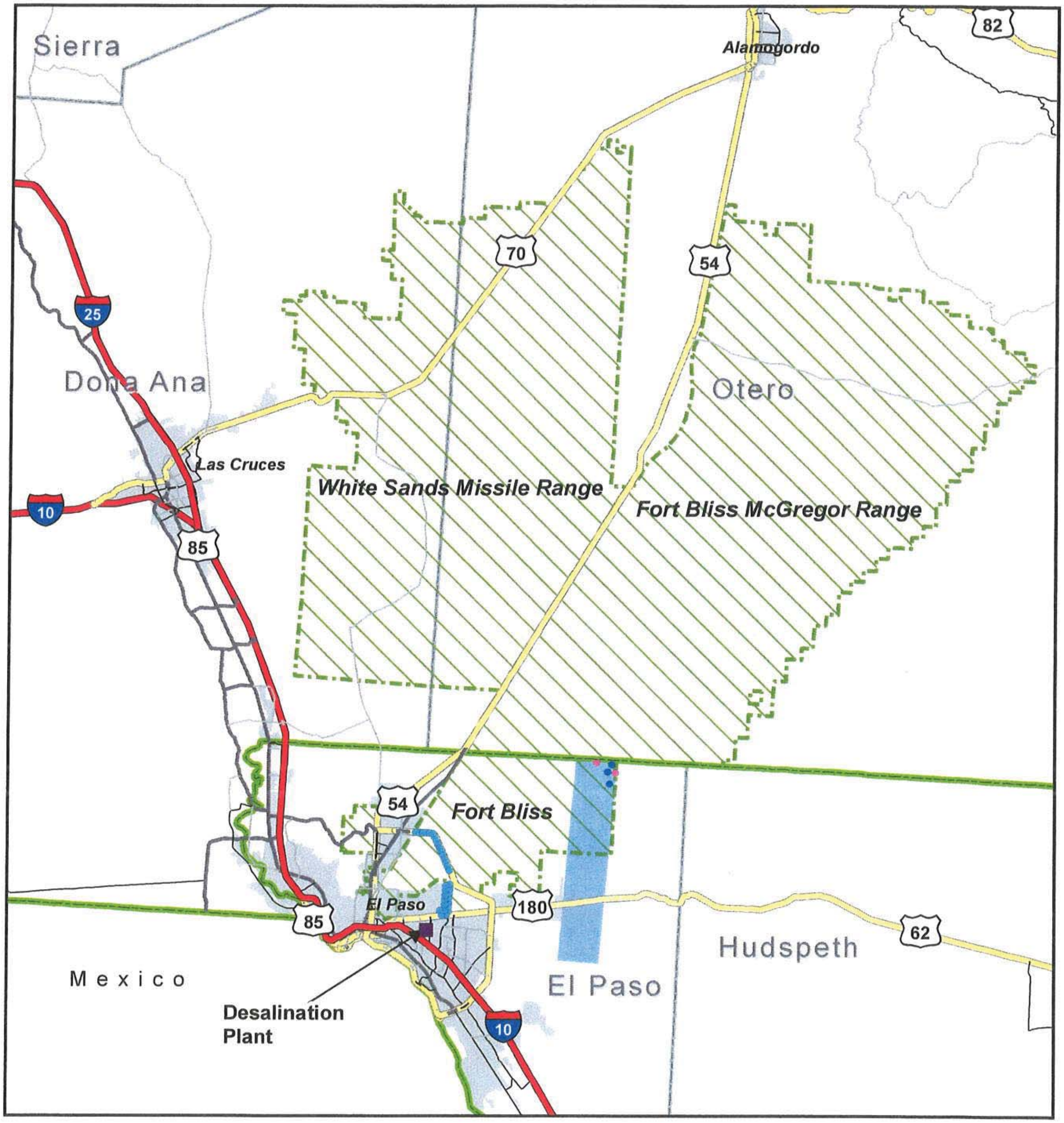
Texas	49-15-611	El Paso County Road & Bridge	Cole Drilling Co.	1986	610		10.75	610	N	Shallow well and does not penetrate injection zone.
Texas	49-15-613	El Paso County Road & Bridge	Unknown	1988	510	--	10	0 – 510	N	Shallow well and does not penetrate injection zone.
Texas	49-15-614	El Paso County Road & Bridge	B&G Drilling	1990	515		6	515	N	Shallow well and does not penetrate injection zone.
Texas	49-15-615	East Mount	Unknown	1985	500	–	–	–	N	Shallow well and does not penetrate injection zone.
Texas	49-15-902	J. Navar	Unknown	–	1,100	--	–	–	N	No sign of well on 8/7/01
Texas	49-15-904	El Paso Natural Gas	Layne Texas	1968	551		–	–	N	No sign of well on 8/7/01
Texas	72872	Jobe Materials	R.L. Guffey, Inc.	2005	592	23	12.75	592	Y	Industrial, reported undesirable water quality, did not complete.
Texas	89984	Jobe Materials	Skinner Drilling	2006	1,100	10	--	–	Y	Borehole and surface completed by prior driller. See #72872.
Texas	49-07-9A	E.W. McCracken	Coles-Aqua Drilling Co.	1983	515	12.25	6-5/8	515	Y	Shallow well and does not penetrate injection zone.
Texas	49-07-9B	Paso View Water Corp.	Richard Lee Helms	1984	545	–	--	–	Y	No water, no completion.
Texas	49-15-3	Galindo Arcenio	Richard Lee Helms	1986	500	14.75	6	500	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-3X	Raul Rodriguez	Joe Salazar	1995	500	9.75	5	500	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-6	George Demings	Richard Lee Helms	1986	502	14.75	6	502	Y	Shallow well and does not penetrate injection zone.
Texas	49-15-6B	John Barnett	Richard Lee Helms	1981	545	10	–	--	Y	No water, no completion.
Texas	49-15-6C	John Barnett	Richard Lee Helms	1981	520	10	--	–	N	No water, no completion.



GENERAL LOCATION MAP

FIGURE 1

LBG-GUYTON ASSOCIATES



Explanation

- Authorized Injection Wells
- Class V Injection Wells
- Production Wells
- State Boundary
- Fort Bliss
- Urban Areas
- Counties
- Proposed Exempt Area

N

0 5 10 20 Miles

GENERAL LOCATION MAP **FIGURE 1**

LBG-GUYTON ASSOCIATES